eagle$_{IO}$

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Tutorials

Version 0.0.2

Reading EAGLE HDF5 files in native Python, with optional multithreading.

See below for tutorials, as well as a description of each of the output properties.

CHAPTER 1

Reading data

The module offers one main function, `read_array`:

```
import eagle_IO.eagle_IO as E

M_200 = E.read_array(fileType,  directory,  tag,   array)
```

`read_array` accepts 4 arguments; the first is a string describing the type of file and data read. The allowed values are:

Value	Description	Example of data that can be read
FOF	FoF group informations	Group centre of mass, group length, group star formation rate
FOF_PARTICLES	IDs of the particles in a FOF group	Particle IDs
SNIP_FOF	FoF group informations (snipshot)	Group centre of mass, group length, group star formation rate
SNIP_FOF_PARTICLES	IDs of the particles in a FOF group (snipshot)	Particle IDs
PARTDATA	Particles that are in a FOF group	Particle Mass, velocity, entropy, stellar age
SNIP_PARTDATA	Particles that are in a FOF group (snipshot)	Particle Mass, velocity, entropy, stellar age
SNAP	Full information about all particles	Particle Mass, velocity, entropy, stellar age
SNIP	Reduced information about all particles	Mass, velocity
SUBFIND	Subhalo information	Subhalo mass, subhalo centre of potential
SUBFIND_GROUP	Subfind halo information	Group centre of potential, M_200, R_500
SUBFIND_PARTICLES	IDs of the particles in a subhalo	Particle IDs
SNIP_SUBFIND	Subhalo information (snipshot)	Subhalo mass, subhalo centre of potential
SNIP_SUBFIND_GROUP	Subfind halo information (snipshot)	Group centre of potential, M_200, R_500
SNIP_SUBFIND_PARTICLES	IDs of the particles in a subhalo (snipshot)	Particle IDs

The second argument is the location of the directory containing the data. For instance:

```
"/cosma5/data/Eagle/ScienceRuns/Planck1/L0100N1504/PE/EagleReference/data/"
```

The third argument is the "tag" of the output. This is the part of the filename that contains the snapshot number and the redshift. For the 29 main output times in the fiducial periodic volumes, the values are:

> "000_z020p000" "001_z015p132" "002_z009p993" "003_z008p988" "004_z008p075" "005_z007p050" "006_z005p971" "007_z005p487" "008_z005p037" "009_z004p485" "010_z003p984" "011_z003p528" "012_z003p017" "013_z002p478" "014_z002p237" "015_z002p012" "017_z001p487" "018_z001p259" "019_z001p004" "020_z000p865" "021_z000p736" "022_z000p615" "023_z000p503" "024_z000p366" "025_z000p271" "026_z000p183" "027_z000p101" "028_z000p000"

The last argument is the name of the array or attribute to be read. For instance:

```
"/PartType4/Metallicity"
```

or:

```
"/PartType5/BH_TimeLastmerger"
```

The routine returns a numpy array containing the values extracted from the files. The order of the elements is preserved and the type of the values is the same as that stored in the HDF5 files.

To read the value of M_200 for all halos at $z = 1.5$ in the reference volume, one would use:

```
import eagle_IO.eagle_IO as E

sim = "/cosma5/data/Eagle/ScienceRuns/Planck1/L0100N1504/PE/EagleReference/data/"
tag = "017_z001p487"

M_200 = E.read_array("SUBFIND_GROUP", sim, tag, "FOF/Group_M_Crit200")
```

CHAPTER 2

Unit conversion

By default, the `read_array` function converts the data read from the file into "h free" physical units. This is done by reading the relevant conversion factors from the HDF5 file. If `verbose` is `True`, the conversions applied to the data are reported by the function and printed to the standard output. This behaviour can be modified using the two optional parameters `noH` and `physicalUnits`. If `noH` is set to `False` then the routine does not apply any h factor correction. If `physicalUnits` is set to `False` then no a-factor correction is applied. Running with `noH=False, physicalUnits=False` will hence read in the data as it is in the file without applying any correction. For instance, reading the particle coordinates at $z = 1$ with this code:

```
pos = E.read_array("SUBFIND_GROUP", sim, tag, "FOF/Group_R_Crit500", noH=True,␣
↪physicalUnits=True)
```

will yield:

```
Converting to physical units. (Multiplication by a^1, a=1)
Converting to h-free units. (Multiplication by h^-1, h=0.6777)
```

This relies on the fact that the units written in the file are correct. Always check that this is the case by looking at the standard output!!

CHAPTER 3

Future Development

- read attributes function
- tests for file existence, file ordering etc.

CHAPTER 4

Snapshot arrays

Particle Type	Array Name	Array Description
PartType0	AExpMaximumTemperature	Expansion factor a when particle had highest temperature|
PartType0	Coordinates	Co-moving coordinates. Physical: r = a x = Coordinates h to the power of-1 a U_L [cm]|
PartType0	Density	Co-moving mass densities. Physical rho = Densities h to the power of2 a to the power of-3 U_M U_L to the power of-3 [g/cm to the power of3]|
PartType0	ElementAbundance/Carbon	||
PartType0	ElementAbundance/Helium	||
PartType0	ElementAbundance/Hydrogen	||
PartType0	ElementAbundance/Iron	||
PartType0	ElementAbundance/Magnesium	||
PartType0	ElementAbundance/Neon	||
PartType0	ElementAbundance/Nitrogen	||
PartType0	ElementAbundance/Oxygen	||
PartType0	ElementAbundance/Silicon	||
PartType0	Entropy	Particle entropy. Physical s = Entropy h to the power of(2-2*GAMMA) UnitPressure UnitDensity to the power of-GAMMA|
PartType0	GroupNumber	FoF group number particle is in|
PartType0	HostHalo_TVir_Mass	Estimate of halo's virial temperature, calculated from the DM halo mass. T_vir = (MEANMOLIONIZED * PROTONMASS / 3. / BOLTZMANN) * (G * m200 * H(z)) to the power of(2./3.) [K]|

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Table 1 – continued from previous page

Particle Type	Array Name	Array Description
PartType0	InternalEnergy	Thermal energy per unit mass. Physical u = InternalEnergy U_V to the power of2 [(cm/s) to the power of2]|
PartType0	IronMassFracFromSNIa	Iron mass from SNIa divided by particle mass. (Initial particle mass for stars)|
PartType0	Mass	Particle mass. Physical m = Mass h to the power of-1 U_M [g]|
PartType0	MaximumTemperature	Maximum temperature ever reached by a particle [K]|
PartType0	MetalMassFracFromAGB	Metal mass from AGB and their progenitors divided by particle mass. (Initial particle mass for stars)|
PartType0	MetalMassFracFromSNII	Metal mass from SNII and their progenitors divided by particle mass. (Initial particle mass for stars)|
PartType0	MetalMassFracFromSNIa	Metal mass from SNIa divided by particle mass. (Initial particle mass for stars)|
PartType0	MetalMassWeightedRedshift	Metal mass weighted redshift at which particle was enriched.|
PartType0	Metallicity	Mass fraction of elements heavier than Helium|
PartType0	OnEquationOfState	Star-formation flag. 0 if has never been star-forming, +ve if currently sf, -ve if not currently sf, value indicates aexp at which it obtained its current state|
PartType0	ParticleIDs	Unique particle identifier|
PartType0	SmoothedElementAbundance/Carbon	|
PartType0	SmoothedElementAbundance/Helium	|
PartType0	SmoothedElementAbundance/Hydrogen	|
PartType0	SmoothedElementAbundance/Iron	|
PartType0	SmoothedElementAbundance/Magnesium	|
PartType0	SmoothedElementAbundance/Neon	|
PartType0	SmoothedElementAbundance/Nitrogen	|
PartType0	SmoothedElementAbundance/Oxygen	|
PartType0	SmoothedElementAbundance/Silicon	|
PartType0	SmoothedIronMassFracFromSNIa	Smoothed mass from SNIa divided by particle mass. (Initial particle mass for stars)|
PartType0	SmoothedMetallicity	Smoothed mass fraction of elements heavier than Helium|
PartType0	SmoothingLength	Co-moving smoothing length. Physical h = SmoothingLength h to the power of-1 a U_L [cm]|
PartType0	StarFormationRate	Gas star formation rate in solar masses / yr|

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Table 1 – continued from previous page

Particle Type	Array Name	Array Description
PartType0	SubGroupNumber	Subgroup number particle is in|
PartType0	Temperature	Temperature [K]|
PartType0	TotalMassFromAGB	Total mass received from AGB and their progenitors|
PartType0	TotalMassFromSNII	Total mass received from SNII and their progenitors|
PartType0	TotalMassFromSNIa	Total mass received from SNIa|
PartType0	Velocity	**Co-moving velocities. Physical v_p = a dx/dt = Veloci** ^
PartType1	Coordinates	Co-moving coordinates. Physical: r = a x = Coordinates h to the power of-1 a U_L [cm]|
PartType1	GroupNumber	FoF group number particle is in|
PartType1	ParticleIDs	Unique particle identifier|
PartType1	SubGroupNumber	Subgroup number particle is in|
PartType1	Velocity	**Co-moving velocities. Physical v_p = a dx/dt = Veloci** ^
PartType4	AExpMaximumTemperature	Expansion factor a when particle had highest temperature|
PartType4	BirthDensity	Local gas density (physical units) when a star particle was born. No a-factor correction as the a-factor at birth time is factored in.|
PartType4	Coordinates	Co-moving coordinates. Physical: r = a x = Coordinates h to the power of-1 a U_L [cm]|
PartType4	ElementAbundance/Carbon	||
PartType4	ElementAbundance/Helium	||
PartType4	ElementAbundance/Hydrogen	||
PartType4	ElementAbundance/Iron	||
PartType4	ElementAbundance/Magnesium	||
PartType4	ElementAbundance/Neon	||
PartType4	ElementAbundance/Nitrogen	||
PartType4	ElementAbundance/Oxygen	||
PartType4	ElementAbundance/Silicon	||
PartType4	Feedback_EnergyFraction	Energy fraction used for SNII feedback (no units).|
PartType4	GroupNumber	FoF group number particle is in|
PartType4	HostHalo_TVir	Halo's virial temperature used in Type II SNe feedback [K]|
PartType4	HostHalo_TVir_Mass	Estimate of halo's virial temperature, calculated from the DM halo mass. T_vir = (MEANMOLIONIZED * PROTONMASS / 3. / BOLTZMANN) * (G * m200 * H(z)) to the power of(2./3.) [K]|

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Table 1 – continued from previous page

Particle Type	Array Name	Array Description
PartType4	InitialMass	Star particle mass at formation time. Physical m = InitialMass h to the power of-1 U_M [g]|
PartType4	IronMassFracFromSNIa	Iron mass from SNIa divided by particle mass. (Initial particle mass for stars)|
PartType4	Mass	Particle mass. Physical m = Mass h to the power of-1 U_M [g]|
PartType4	MaximumTemperature	Maximum temperature ever reached by a particle [K]|
PartType4	MetalMassFracFromAGB	Metal mass from AGB and their progenitors divided by particle mass. (Initial particle mass for stars)|
PartType4	MetalMassFracFromSNII	Metal mass from SNII and their progenitors divided by particle mass. (Initial particle mass for stars)|
PartType4	MetalMassFracFromSNIa	Metal mass from SNIa divided by particle mass. (Initial particle mass for stars)|
PartType4	MetalMassWeightedRedshift	Metal mass weighted redshift at which particle was enriched.|
PartType4	Metallicity	Mass fraction of elements heavier than Helium|
PartType4	ParticleIDs	Unique particle identifier|
PartType4	PreviousStellarEnrichment	This is the expansion factor when the star last did enrichment.|
PartType4	SmoothedElementAbundance/Carbon	||
PartType4	SmoothedElementAbundance/Helium	||
PartType4	SmoothedElementAbundance/Hydrogen	||
PartType4	SmoothedElementAbundance/Iron	||
PartType4	SmoothedElementAbundance/Magnesium	||
PartType4	SmoothedElementAbundance/Neon	||
PartType4	SmoothedElementAbundance/Nitrogen	||
PartType4	SmoothedElementAbundance/Oxygen	||
PartType4	SmoothedElementAbundance/Silicon	||
PartType4	SmoothedIronMassFracFromSNIa	Smoothed mass from SNIa divided by particle mass. (Initial particle mass for stars)|
PartType4	SmoothedMetallicity	Smoothed mass fraction of elements heavier than Helium|
PartType4	SmoothingLength	Co-moving smoothing length. Physical h = SmoothingLength h to the power of-1 a U_L [cm]|
PartType4	StellarEnrichmentCounter	The counter shows the number of time steps since enrichment was last done.|
PartType4	StellarFormationTime	Expansion factor a when star particle was born|
PartType4	SubGroupNumber	Subgroup number particle is in|

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Table 1 – continued from previous page

Particle Type	Array Name	Array Description
PartType4	TotalMassFromAGB	Total mass received from AGB and their progenitors|
PartType4	TotalMassFromSNII	Total mass received from SNII and their progenitors|
PartType4	TotalMassFromSNIa	Total mass received from SNIa|
PartType4	Velocity	**Co-moving velocities. Physical v_p = a dx/dt = Veloci** ^
PartType5	BH_AccretionLength	BH smoothing length.|
PartType5	BH_CumlAccrMass	Cumulative mass accreted by largest progenitor of this BH. Physical m = Mass h to the power of-1 U_M [g]|
PartType5	BH_CumlNumSeeds	Cumulative number of BH seeds swallowed by this BH.|
PartType5	BH_Density	Co-moving black hole densities. Physical rho = Densities h to the power of2 a to the power of-3 U_M U_L to the power of-3 [g/cm to the power of3]|
PartType5	BH_EnergyReservoir	Black hole energy reservoir for thermal feedback.|
PartType5	BH_FormationTime	Expansion factor a when BH particle was born|
PartType5	BH_Mass	BH mass. Physical m = Mass h to the power of-1 U_M [g]|
PartType5	BH_Mdot	BH accretion rate. Physical mdot = BH_Mdot h to the power of-1 U_M /U_T [g/s]|
PartType5	BH_MostMassiveProgenitorID	Unique ID of the most massive progenitor of this BH. At each merger event, the ID of the most massive of the two merging BHs is stored in this array.|
PartType5	BH_Pressure	Black hole surrounding gas pressure. Physical P = Pressure h to the power of2 a to the power of(-3*GAMMA) U_M U_V to the power of2 U_L to the power of-3 [g cm to the power of-1 s to the power of-2]|
PartType5	BH_SoundSpeed	Black hole surrounding gas sound speed. Physical c_snd = C_snd U_V [cm/s]|
PartType5	BH_SurroundingGasVel	Velocity of the gas surrounding the BH (kernel weighted). Physical Velocity = Velocity a to the power of-1 U_M U_V to the power of [cm/s]|

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Table 1 – continued from previous page

Particle Type	Array Name	Array Description
PartType5	BH_TimeLastMerger	Expansion factor a when BH particle last accreted an other BH. 0 if the particle as never accreted another BH. |
PartType5	BH_WeightedDensity	Co-moving weighted black hole densities. Physical rho = Densities h to the power of2 a to the power of-3 U_M U_L to the power of-3 [g/cm to the power of3]|
PartType5	Coordinates	Co-moving coordinates. Physical: r = a x = Coordinates h to the power of-1 a U_L [cm]|
PartType5	GroupNumber	FoF group number particle is in|
PartType5	HostHalo_TVir_Mass	Estimate of halo's virial temperature, calculated from the DM halo mass. T_vir = (MEANMOLIONIZED * PROTONMASS / 3. / BOLTZMANN) * (G * m200 * H(z)) to the power of(2./3.) [K]|
PartType5	Mass	Particle mass. Physical m = Mass h to the power of-1 U_M [g] |
PartType5	ParticleIDs	Unique particle identifier|
PartType5	SmoothingLength	Co-moving smoothing length. Physical h = SmoothingLength h to the power of-1 a U_L [cm]|
PartType5	SubGroupNumber	Subgroup number particle is in|
PartType5	Velocity	Co-moving velocities. Physical v_p = a dx/dt = Velocities a to the power of1/2 U_V [cm/s]|

CHAPTER 5

FOF arrays

Group numbers begin at 1. Spherical overdensities associated with a FOF group use the negative of the group number. A particle can only be associated with one spherical overdensity.

The following arrays can be found in the FOF group files:

Group	Array Name	Description
FOF	BH_Mdot	Particle mass. Physical m = Mass h to the power of-1 U_M [g] |
FOF	BlackHoleMass	Particle mass. Physical m = Mass h to the power of-1 U_M [g] |
FOF	CentreOfMass	Co-moving coordinates. Physical: r = a x = Coordinates h to the power of-1 a U_L [cm] |
FOF	GroupLength	Number of particles in this group |
FOF	GroupLengthType	Number of particles in this group of a given type |
FOF	GroupMassType	Particle mass. Physical m = Mass h to the power of-1 U_M [g] |
FOF	GroupOffset	Offset of IDs of this group, starts at 0 |
FOF	GroupOffsetType	Meaning of this variable has not yet been defined. |
FOF	Mass	Particle mass. Physical m = Mass h to the power of-1 U_M [g] |
FOF	NSF/AExpMaximumTemperature	Expansion factor a when particle had highest temperature |
FOF	NSF/ElementAbundances/Carbon	

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Table 1 – continued from previous page

Group	Array Name	Description
FOF	NSF/ElementAbundances/Helium	
FOF	NSF/ElementAbundances/Hydrogen	
FOF	NSF/ElementAbundances/Iron	
FOF	NSF/ElementAbundances/Magnesium	
FOF	NSF/ElementAbundances/Neon	
FOF	NSF/ElementAbundances/Nitrogen	
FOF	NSF/ElementAbundances/Oxygen	
FOF	NSF/ElementAbundances/Silicon	
FOF	NSF/Entropy	Meaning of this variable has not yet been defined. |
FOF	NSF/Mass	Particle mass. Physical m = Mass h to the power of-1 U_M [g] |
FOF	NSF/MaximumTemperature	Maximum temperature ever reached by a particle [K] |
FOF	NSF/Metallicity	Mass fraction of elements heavier than Helium |
FOF	NSF/SmoothedElementAbundances/Carbon	
FOF	NSF/SmoothedElementAbundances/Helium	
FOF	NSF/SmoothedElementAbundances/Hydrogen	
FOF	NSF/SmoothedElementAbundances/Iron	
FOF	NSF/SmoothedElementAbundances/Magnesium	
FOF	NSF/SmoothedElementAbundances/Neon	

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Table 1 – continued from previous page

Group	Array Name	Description
FOF	NSF/SmoothedElementAbundances/Nitrogen	
FOF	NSF/SmoothedElementAbundances/Oxygen	
FOF	NSF/SmoothedElementAbundances/Silicon	
FOF	NSF/SmoothedIronMassFracFromSNIa	Smoothed mass from SNIa divided by particle mass. (Initial particle mass for stars) |
FOF	NSF/SmoothedMetallicity	Smoothed mass fraction of elements heavier than Helium |
FOF	NSF/Temperature	Meaning of this variable has not yet been defined. |
FOF	ParticleIDs	Unique particle identifier |
FOF	SF/AExpMaximumTemperature	Expansion factor a when particle had highest temperature |
FOF	SF/ElementAbundaces/Carbon	
FOF	SF/ElementAbundaces/Helium	
FOF	SF/ElementAbundaces/Hydrogen	
FOF	SF/ElementAbundaces/Iron	
FOF	SF/ElementAbundaces/Magnesium	
FOF	SF/ElementAbundaces/Neon	
FOF	SF/ElementAbundaces/Nitrogen	
FOF	SF/ElementAbundaces/Oxygen	
FOF	SF/ElementAbundaces/Silicon	
FOF	SF/Entropy	Meaning of this variable has not yet been defined. |

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Table 1 – continued from previous page

Group	Array Name	Description
FOF	SF/IronMassFracFromSNIa	Iron mass from SNIa divided by particle mass. (Initial particle mass for stars) |
FOF	SF/Mass	Particle mass. Physical m = Mass h to the power of-1 U_M [g] |
FOF	SF/MaximumTemperature	Maximum temperature ever reached by a particle [K] |
FOF	SF/Metallicity	Mass fraction of elements heavier than Helium |
FOF	SF/SmoothedElementAbundances/Carbon	
FOF	SF/SmoothedElementAbundances/Helium	
FOF	SF/SmoothedElementAbundances/Hydrogen	
FOF	SF/SmoothedElementAbundances/Iron	
FOF	SF/SmoothedElementAbundances/Magnesium	
FOF	SF/SmoothedElementAbundances/Neon	
FOF	SF/SmoothedElementAbundances/Nitrogen	
FOF	SF/SmoothedElementAbundances/Oxygen	
FOF	SF/SmoothedElementAbundances/Silicon	
FOF	SF/SmoothedIronMassFracFromSNIa	Smoothed mass from SNIa divided by particle mass. (Initial particle mass for stars) |
FOF	SF/SmoothedMetallicity	Smoothed mass fraction of elements heavier than Helium |
FOF	SF/Temperature	Meaning of this variable has not yet been defined. |
FOF	StarFormationRate	Gas star formation rate in solar masses / yr |
FOF	Stars/AExpMaximumTemperature	Expansion factor a when particle had highest temperature |
FOF	Stars/ElementAbundances/Carbon	

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Table 1 – continued from previous page

Group	Array Name	Description
FOF	Stars/ElementAbundances/Helium	
FOF	Stars/ElementAbundances/Hydrogen	
FOF	Stars/ElementAbundances/Iron	
FOF	Stars/ElementAbundances/Magnesium	
FOF	Stars/ElementAbundances/Neon	
FOF	Stars/ElementAbundances/Nitrogen	
FOF	Stars/ElementAbundances/Oxygen	
FOF	Stars/ElementAbundances/Silicon	
FOF	Stars/InitialMass	Star particle mass at formation time. Physical m = InitialMass h to the power of-1 U_M [g] |
FOF	Stars/InitialMassWeightedStellarAge	Expansion factor a when star particle was born |
FOF	Stars/IronMassFracFromSNIa	Iron mass from SNIa divided by particle mass. (Initial particle mass for stars) |
FOF	Stars/Mass	Particle mass. Physical m = Mass h to the power of-1 U_M [g] |
FOF	Stars/MaximumTemperature	Maximum temperature ever reached by a particle [K] |
FOF	Stars/Metallicity	Mass fraction of elements heavier than Helium |
FOF	Stars/SmoothedElementAbundances/Carbon	
FOF	Stars/SmoothedElementAbundances/Helium	
FOF	Stars/SmoothedElementAbundances/Hydrogen	
FOF	Stars/SmoothedElementAbundances/Iron	

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Table 1 – continued from previous page

Group	Array Name	Description
FOF	Stars/SmootheElementAbundances/Magnesium	
FOF	Stars/SmootheElementAbundances/Neon	
FOF	Stars/SmootheElementAbundances/Nitrogen	
FOF	Stars/SmootheElementAbundances/Oxygen	
FOF	Stars/SmootheElementAbundances/Silicon	
FOF	Stars/SmoothedIronMassFracFromSNIa	Smoothed mass from SNIa divided by particle mass. (Initial particle mass for stars) |
FOF	Stars/SmoothedMetallicity	Smoothed mass fraction of elements heavier than Helium |
FOF	Velocity	Co-moving velocities. Physical v_p = a dx/dt = Velocities a to the power of1/2 U_V [cm/s]((A bug affects this quantity. The correct factor is a^-1 and not a^0.5)) |

CHAPTER 6

Subfind arrays

Subgroup numbers begin at 0. Subgroup 0 of a FOF group corresponds to the most massive subgroup within the group.

The following arrays can be found in the Eagle subfind files:

Group	Array Name	Description
FOF	ContaminationMass	Contaminating mass. Physical M = Mass U_M[g] |
FOF	FirstSubhaloID	Index of first sub halo in SubHalo list (starts at 0) |
FOF	GroupCentreOfPotential	Co-moving position of most bound particle. Physical position = positio
FOF	GroupLength	Number of particles in this group |
FOF	GroupMass	Total mass of FoF group. Physical M = Mass h to the power of-1 U_M
FOF	GroupOffset	Offset of IDs of this group, starts at 0 |
FOF	Group_M_Crit200	Mass within Rcrit200. Physical M = Mass h to the power of-1 U_M[g]
FOF	Group_M_Crit2500	M_Crit2500 |
FOF	Group_M_Crit500	M_Crit500 |
FOF	Group_M_Mean200	Mass within RMean200. Physical M = Mass h to the power of-1 U_M
FOF	Group_M_Mean2500	M_Mean2500 |
FOF	Group_M_Mean500	M_Mean500 |
FOF	Group_M_TopHat200	Mass within RTophat200. Physical M = Mass h to the power of-1 U_M
FOF	Group_R_Crit200	Co-moving radius within which density is 200 times critical density. P
FOF	Group_R_Crit2500	R_Crit2500 |
FOF	Group_R_Crit500	R_Crit500 |
FOF	Group_R_Mean200	Co-moving radius within which density is 200 times mean density. Phy
FOF	Group_R_Mean2500	R_Mean2500 |
FOF	Group_R_Mean500	R_Mean500 |
FOF	Group_R_TopHat200	Co-moving radius within which density is 200 times (18 * pi to the pow
FOF	NumOfSubhalos	Number of subhaloes in this FoF group |
^ ^		
IDs	ParticleID	PID |
IDs	Particle_Binding_Energy	Binding energy of particles |
^ ^		

Group	Array Name	Description
Subhalo	ApertureMeasurements/Mass/001kpc	Masses within apertures from 1 to 100 kpc (physical) of the centre of p
Subhalo	ApertureMeasurements/Mass/003kpc	Masses within apertures from 1 to 100 kpc (physical) of the centre of p
Subhalo	ApertureMeasurements/Mass/005kpc	Masses within apertures from 1 to 100 kpc (physical) of the centre of p
Subhalo	ApertureMeasurements/Mass/010kpc	Masses within apertures from 1 to 100 kpc (physical) of the centre of p
Subhalo	ApertureMeasurements/Mass/020kpc	Masses within apertures from 1 to 100 kpc (physical) of the centre of p
Subhalo	ApertureMeasurements/Mass/030kpc	Masses within apertures from 1 to 100 kpc (physical) of the centre of p
Subhalo	ApertureMeasurements/Mass/040kpc	Masses within apertures from 1 to 100 kpc (physical) of the centre of p
Subhalo	ApertureMeasurements/Mass/050kpc	Masses within apertures from 1 to 100 kpc (physical) of the centre of p
Subhalo	ApertureMeasurements/Mass/070kpc	Masses within apertures from 1 to 100 kpc (physical) of the centre of p
Subhalo	ApertureMeasurements/Mass/100kpc	Masses within apertures from 1 to 100 kpc (physical) of the centre of p
Subhalo	ApertureMeasurements/SFR/001kpc	Star formation rate within apertures from 1 to 100 kpc (physical) of the
Subhalo	ApertureMeasurements/SFR/003kpc	Star formation rate within apertures from 1 to 100 kpc (physical) of the
Subhalo	ApertureMeasurements/SFR/005kpc	Star formation rate within apertures from 1 to 100 kpc (physical) of the
Subhalo	ApertureMeasurements/SFR/010kpc	Star formation rate within apertures from 1 to 100 kpc (physical) of the
Subhalo	ApertureMeasurements/SFR/020kpc	Star formation rate within apertures from 1 to 100 kpc (physical) of the
Subhalo	ApertureMeasurements/SFR/030kpc	Star formation rate within apertures from 1 to 100 kpc (physical) of the
Subhalo	ApertureMeasurements/SFR/040kpc	Star formation rate within apertures from 1 to 100 kpc (physical) of the
Subhalo	ApertureMeasurements/SFR/050kpc	Star formation rate within apertures from 1 to 100 kpc (physical) of the
Subhalo	ApertureMeasurements/SFR/070kpc	Star formation rate within apertures from 1 to 100 kpc (physical) of the
Subhalo	ApertureMeasurements/SFR/100kpc	Star formation rate within apertures from 1 to 100 kpc (physical) of the
Subhalo	ApertureMeasurements/VelDisp/001kpc	Stellar velocity dispersion within apertures from 1 to 100 kpc (physica
Subhalo	ApertureMeasurements/VelDisp/003kpc	Stellar velocity dispersion within apertures from 1 to 100 kpc (physica
Subhalo	ApertureMeasurements/VelDisp/005kpc	Stellar velocity dispersion within apertures from 1 to 100 kpc (physica
Subhalo	ApertureMeasurements/VelDisp/010kpc	Stellar velocity dispersion within apertures from 1 to 100 kpc (physica
Subhalo	ApertureMeasurements/VelDisp/020kpc	Stellar velocity dispersion within apertures from 1 to 100 kpc (physica
Subhalo	ApertureMeasurements/VelDisp/030kpc	Stellar velocity dispersion within apertures from 1 to 100 kpc (physica
Subhalo	ApertureMeasurements/VelDisp/040kpc	Stellar velocity dispersion within apertures from 1 to 100 kpc (physica
Subhalo	ApertureMeasurements/VelDisp/050kpc	Stellar velocity dispersion within apertures from 1 to 100 kpc (physica
Subhalo	ApertureMeasurements/VelDisp/070kpc	Stellar velocity dispersion within apertures from 1 to 100 kpc (physica
Subhalo	ApertureMeasurements/VelDisp/100kpc	Stellar velocity dispersion within apertures from 1 to 100 kpc (physica
Subhalo	BlackHoleMass	BH mass. Physical m = Mass h to the power of-1 U_M [g] |
Subhalo	BlackHoleMassAccretionRate	BH accretion rate. Physical mdot = BH_Mdot h to the power of-1 U_M
Subhalo	CentreOfMass	Co-moving position of COM. Physical position = position h to the pow
Subhalo	CentreOfPotential	Co-moving position of most bound particle. Physical position = positio
Subhalo	GasSpin	Angular momentum per unit mass of gas particles |
Subhalo	GroupNumber	FOF Group Number subhalo belongs to |
Subhalo	HalfMassProjRad	Projected (av. over 3 axes) radius enclosing half of the subhalo mass co
Subhalo	HalfMassRad	Radius enclosing half of the subhalo mass comprised by each particle t
Subhalo	IDMostBound	Particle ID of lowest *total* energy particle |
Subhalo	InertiaTensor	Matrix for the second moment of matter distribution. ¹⁾|
Subhalo	InitialMassWeightedBirthZ	Initial mass weighted metallicity of stars |
Subhalo	InitialMassWeightedStellarAge	Initial mass weighted age of stars in Gyr |
Subhalo	KineticEnergy	Total kinetic energy of particles bound to this halo |
Subhalo	Mass	Total mass of this group. Physical M = Mass h to the power of-1 U_M
Subhalo	MassTwiceHalfMassRad	Mass contained within twice the half mass radius for each particle type
Subhalo	MassType	Total mass of this group for each particle type. Physical M = Mass h to
Subhalo	NSF/ElementAbundances/Carbon	((Some values are incorrect, see [[eagle:simulations:simulation_overvi
Subhalo	NSF/ElementAbundances/Helium	²⁾|
Subhalo	NSF/ElementAbundances/Hydrogen	²⁾ |

Group	Array Name	Description
Subhalo	NSF/ElementAbundances/Iron	²⁾ |
Subhalo	NSF/ElementAbundances/Magnesium	²⁾ |
Subhalo	NSF/ElementAbundances/Neon	²⁾ |
Subhalo	NSF/ElementAbundances/Nitrogen	²⁾ |
Subhalo	NSF/ElementAbundances/Oxygen	²⁾ |
Subhalo	NSF/ElementAbundances/Silicon	²⁾ |
Subhalo	NSF/IronFromSNIa	Iron from SNIa |
Subhalo	NSF/IronFromSNIaSmoothed	Smoothed iron from SNIa |
Subhalo	NSF/KineticEnergy	Kinetic energy of NSF gas |
Subhalo	NSF/Mass	Mass |
Subhalo	NSF/MassFromAGB	Mass from AGB |
Subhalo	NSF/MassFromSNII	Mass from SNII |
Subhalo	NSF/MassFromSNIa	Mass from SNIa |
Subhalo	NSF/MassWeightedEntropy	Mass weighted mean entropy of NSF gas |
Subhalo	NSF/MassWeightedPotential	Mass weighted potential |
Subhalo	NSF/MassWeightedTemperature	Mass weighted mean temperature of NSF gas |
Subhalo	NSF/Metallicity	Metallicity weighted by mass of non star forming gas in subhalos |
Subhalo	NSF/MetalsFromAGB	Mass in metals from AGB |
Subhalo	NSF/MetalsFromSNII	Mass in metals from SNII |
Subhalo	NSF/MetalsFromSNIa	Mass in metals from SNIa |
Subhalo	NSF/SmootheElementAbuncdances/Carbon	²⁾ |
Subhalo	NSF/SmootheElementAbuncdances/Helium	²⁾ |
Subhalo	NSF/SmootheElementAbuncdances/Hydrogen	²⁾ |
Subhalo	NSF/SmootheElementAbuncdances/Iron	²⁾ |
Subhalo	NSF/SmootheElementAbuncdances/Magnesium	²⁾ |
Subhalo	NSF/SmootheElementAbuncdances/Neon	²⁾ |
Subhalo	NSF/SmootheElementAbuncdances/Nitrogen	²⁾ |
Subhalo	NSF/SmootheElementAbuncdances/Oxygen	²⁾ |
Subhalo	NSF/SmootheElementAbuncdances/Silicon	²⁾ |
Subhalo	NSF/SmoothedMetallicity	Smoothed metallicity weighted by mass of non star forming gas in sub
Subhalo	NSF/Spin	Angular momentum per unit mass of non-star-forming gas particles |
Subhalo	NSF/ThermalEnergy	Thermal energy of NSF gas |
Subhalo	NSF/TotalEnergy	Total energy of NSF gas |
Subhalo	SF/ElementAbundances/Carbon	²⁾ |
Subhalo	SF/ElementAbundances/Helium	²⁾ |
Subhalo	SF/ElementAbundances/Hydrogen	²⁾ |
Subhalo	SF/ElementAbundances/Iron	²⁾ |
Subhalo	SF/ElementAbundances/Magnesium	²⁾ |
Subhalo	SF/ElementAbundances/Neon	²⁾ |
Subhalo	SF/ElementAbundances/Nitrogen	²⁾ |
Subhalo	SF/ElementAbundances/Oxygen	²⁾ |
Subhalo	SF/ElementAbundances/Silicon	²⁾ |
Subhalo	SF/IronFromSNIa	Iron from SNIa |
Subhalo	SF/IronFromSNIaSmoothed	Smoothed iron from SNIa |
Subhalo	SF/KineticEnergy	Kinetic energy of SF gas |
Subhalo	SF/Mass	Mass |
Subhalo	SF/MassFromAGB	Mass from AGB |
Subhalo	SF/MassFromSNII	Mass from SNII |
Subhalo	SF/MassFromSNIa	Mass from SNIa |

Group	Array Name	Description
Subhalo	SF/MassWeightedEntropy	Mass weighted mean entropy of SF gas |
Subhalo	SF/MassWeightedPotential	Mass weighted potential |
Subhalo	SF/MassWeightedTemperature	Mass weighted mean temperature of SF gas |
Subhalo	SF/Metallicity	Metallicity weighted by mass of star forming gas in subhalos |
Subhalo	SF/MetalsFromAGB	Mass in metals from AGB |
Subhalo	SF/MetalsFromSNII	Mass in metals from SNII |
Subhalo	SF/MetalsFromSNIa	Mass in metals from SNIa |
Subhalo	SF/SFWeightedMetallicity	Metallicity weighted by star formation rate of star forming gas in subh
Subhalo	SF/SmoothedElementAbundances/Carbon	²⁾ |
Subhalo	SF/SmoothedElementAbundances/Helium	²⁾ |
Subhalo	SF/SmoothedElementAbundances/Hydrogen	²⁾ |
Subhalo	SF/SmoothedElementAbundances/Iron	²⁾ |
Subhalo	SF/SmoothedElementAbundances/Magnesium	²⁾ |
Subhalo	SF/SmoothedElementAbundances/Neon	²⁾ |
Subhalo	SF/SmoothedElementAbundances/Nitrogen	²⁾ |
Subhalo	SF/SmoothedElementAbundances/Oxygen	²⁾ |
Subhalo	SF/SmoothedElementAbundances/Silicon	²⁾ |
Subhalo	SF/SmoothedMetallicity	Smoothed metallicity weighted by mass of star forming gas in subhalo
Subhalo	SF/SmoothedSFWeightedMetallicity	Smoothed metallicity weighted by star formation rate of star forming g
Subhalo	SF/Spin	Angular momentum per unit mass of star-forming gas particles |
Subhalo	SF/ThermalEnergy	Thermal energy of SF gas |
Subhalo	SF/TotalEnergy	Total energy of SF gas |
Subhalo	StarFormationRate	Total gas star formation rate in solar masses / yr |
Subhalo	Stars/ElementAbundances/Carbon	²⁾ |
Subhalo	Stars/ElementAbundances/Helium	²⁾ |
Subhalo	Stars/ElementAbundances/Hydrogen	²⁾ |
Subhalo	Stars/ElementAbundances/Iron	²⁾ |
Subhalo	Stars/ElementAbundances/Magnesium	²⁾ |
Subhalo	Stars/ElementAbundances/Neon	²⁾ |
Subhalo	Stars/ElementAbundances/Nitrogen	²⁾ |
Subhalo	Stars/ElementAbundances/Oxygen	²⁾ |
Subhalo	Stars/ElementAbundances/Silicon	²⁾ |
Subhalo	Stars/IronFromSNIa	Iron from SNIa |
Subhalo	Stars/IronFromSNIaSmoothed	Smoothed iron from SNIa |
Subhalo	Stars/KineticEnergy	Kinetic energy of stars |
Subhalo	Stars/Mass	Mass in stars |
Subhalo	Stars/MassFromAGB	Mass from AGB |
Subhalo	Stars/MassFromSNII	Mass from SNII |
Subhalo	Stars/MassFromSNIa	Mass from SNIa |
Subhalo	Stars/MassWeightedPotential	Mass weighted potential |
Subhalo	Stars/Metallicity	Metallicity weighted by mass of stars in subhalos |
Subhalo	Stars/MetalsFromAGB	Mass in metals from AGB |
Subhalo	Stars/MetalsFromSNII	Mass in metals from SNII |
Subhalo	Stars/MetalsFromSNIa	Mass in metals from SNIa |
Subhalo	Stars/SmoothedElementAbundances/Carbon	²⁾ |
Subhalo	Stars/SmoothedElementAbundances/Helium	²⁾ |
Subhalo	Stars/SmoothedElementAbundances/Hydrogen	²⁾ |
Subhalo	Stars/SmoothedElementAbundances/Iron	²⁾ |
Subhalo	Stars/SmoothedElementAbundances/Magnesium	²⁾ |

Group	Array Name	Description
Subhalo	Stars/SmoothedElementAbundances/Neon	²⁾ |
Subhalo	Stars/SmoothedElementAbundances/Nitrogen	²⁾ |
Subhalo	Stars/SmoothedElementAbundances/Oxygen	²⁾ |
Subhalo	Stars/SmoothedElementAbundances/Silicon	²⁾ |
Subhalo	Stars/SmoothedMetallicity	Smoothed metallicity weighted by mass of stars in subhalos |
Subhalo	Stars/Spin	Angular momentum per unit mass of star particles |
Subhalo	Stars/TotalEnergy	Total energy of stars |
Subhalo	StellarInitialMass	Stellar initial mass |
Subhalo	StellarVelDisp	Stellar velocity dispersion ¹⁾|
Subhalo	StellarVelDisp_HalfMassProjRad	Stellar velocity dispersion within half mass radius ¹⁾|
Subhalo	SubGroupNumber	SubGroup Number of subhalo, begins at 0 for most massive subhalo w
Subhalo	SubLength	Number of particles in this subhalo |
Subhalo	SubLengthType	Number of particles of each type in this subhalo |
Subhalo	SubOffset	Offset of IDs in this subhalo. Starts at 0 |
Subhalo	ThermalEnergy	Total thermal energy of particles bound to this halo |
Subhalo	TotalEnergy	Total energy of particles bound to this halo |
Subhalo	Velocity	Vel |
Subhalo	Vmax	Co-moving maximum circular velocity. Physical velocity = ??? |
Subhalo	VmaxRadius	VmaxRad |

CHAPTER 7

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- Aswin Vijayan
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CHAPTER 8

License & Attribution

CHAPTER 9

Changelog

9.1 0.0.2 (04-09-2019)

- CGS unit conversions added.

9.2 0.0.1 (01-08-2019)

- Initial release.